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SCIENTIFIC WORK IN THE SEA-FISHERIES.

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Part I.

Before proceeding with the main subject of this memoir—*viz.* the light which science has thrown on the sea-fisheries of our country—it may be well to take a brief glance at the condition of this great—it may almost be said national—industry from the earlier times to the period when the aid of science was brought to bear on it.

As might be expected, the most remote past is veiled in obscurity, for Britain had neither an Aristotle nor a Strabo, but authors* from the third century onwards, such as Solinus and Dion Cassius, as Dr. Fulton tells us, give occasional references to sea-fishes as the food of certain of the natives, or as occurring in numbers off the British coasts. Though the sea-fisheries of the country doubtless became more important in the subsequent centuries, they were far behind those of other nations, such as the Scandinavians, who led the way in the Herring fishery, and the Hanseatic leaguers, who supplied Catholic Europe with Herrings. No nation, however, took a more prominent part than

* An interesting series of articles by Dr. Fulton on this head appeared in the 'Fish Trades Gazette' for 1893, and from which some of the facts have been drawn. I have to thank Dr. Williamson for kindly aiding me in this respect.

the Dutch, the enterprising successors of the Hanseatic leaguers, whose fleet of over two thousand "busses" swept the North Sea from Shetland to the Dogger, as well as searched the inshore waters all along the English coasts—to the chagrin of the native fishermen in the sixteenth and first half of the seventeenth century. It was not, indeed, till the middle of the seventeenth century that the supremacy of the Dutch was overthrown, and that British fishermen took the foremost place in sea-fishing.

Throughout all this period the horizon of the sea-fisheries was often as cloudy as now, and occasionally even more so, for once in the thirteenth century armed Flemish fishermen attacked the unarmed English boats, and killed more than a thousand of their crews. Regulations as to close-times, meshes of nets, and small or immature fishes were frequently made, showing the anxiety of the legislature as to the safety of the sea-fisheries. Even in Parliament, more than three hundred years ago, it was said that "in divers places they fed swine and dogs on the fry and spawn of fishes, and otherwise, lamentable and horrible to be reported, destroy the same—to the great hindrance and decay of the Commonwealth."

Since Britain attained supremacy in the sea-fisheries ever-recurring fears as to their decline have been conspicuous. Now it was the destruction of small Turbot on the sandy shores that aroused attention, for London as early as the seventeenth century needed eighty thousand Turbot *per annum*. Again, it was the incursions of French fishermen on the inshore grounds—especially after the peace following Waterloo—that caused the native fishermen to petition Parliament to stop what they considered the ruin of the British industry.

Ever the same distrust of the permanence of the supplies of the sea-fishes, and the intolerance of other methods of fishing than that thought to be legitimate by the local men, have characterized the chequered history of the subject. Yet throughout all these centuries the plenitude of the sea-fishes was beyond dispute. Moreover, successive Governments, whether representing the wishes of the people or not—both in England and Scotland—have always taken an exceptionally favourable view of the daring and hardy toilers of the sea, since amongst other things, their ranks furnished the finest recruits for the Navy. Inquiries

and Commissions were numerous, and in the seventeenth century many protective Acts were passed, and companies floated to encourage the struggling fisheries; whilst in the eighteenth century the bounty-system was instituted, and was abolished only in 1830.

Of the Commissions, it is only necessary to allude to one or two. Thus, in 1833, the Commissioners appointed by the House of Commons reported that the fishes of the British Channel had been declining since the peace of 1815, that the numbers of boats and men were decreasing, and that the fishermen and their families were dependent on the poor-rates for support. Now at that time it must have been extremely difficult to arrive at a right conclusion, since statistics of value were almost non-existent, and the Commissioners had little else to rely on than the evidence placed before them. It is at any rate certain that at that period comparatively few fishermen had a knowledge of the finny wealth of the Channel.

A great change was apparent in the Report of the Royal Commission of 1866. The Commissioners (Sir James Caird, Prof. Huxley, and Mr. Shaw Lefevre), after a prolonged inquiry, had no difficulty in coming to the conclusion that the supply of fish is increasing, and admits of progressive increase. Yet the Commissioners were not then fully aware of the marvellous powers of reproduction and the complex life-histories of the fishes. It has also to be remembered that the mode of fishing known as trawling (though a very old method) had not been developed as it now is, yet England had no less than nine hundred and fifty-five sailing trawlers working in the North Sea and St. George's Channel, that were estimated to supply three hundred tons of fish daily.

Shortly afterwards (1871) the United States Fish-Commission sprang into existence, mainly from the complaints as to the diminution of the stock on the American fishing-grounds. In a few years (1878) this Commission commenced the hatching of sea-fishes, with what success will subsequently be shown.

The conclusions arrived at by the Commission of 1866 held for twelve years, when complaints by the liners caused Parliament to arrange for a Commission of two (Messrs. Buckland and Walpole) to carry out an inquiry on the same lines as the last.

The Commissioners reported (1878) to the same effect in regard to the abundance of fishes, and the absence of wasteful destruction, and they made various suggestions concerning injuries done by trawlers to lines and nets. Steam-trawling had then begun.

The occurrence of Fisheries Exhibitions in France, Germany, and Holland, as well as that at Norwich, stimulated the interest of the public in the Department, and led to a notable exhibition in Edinburgh in 1882, and next year to the still larger exhibition in London, from which emanated volumes of valuable addresses and papers.

The rapid extension of steam-trawling and its spread into Scottish waters gave the Government little respite, for in 1883 the pressure brought to bear was so great that a Royal Commission (Lord Dalhousie's)—comprehending, besides the Chairman, Mr. Marjoribanks (now Lord Tweedmouth), Prof. Huxley, Mr. Caine, and the late Sir Thomas Brady—was appointed to inquire into the complaints of the injuries done to the line and drift-net fishermen, and to ascertain what legislative remedy can be adopted without interfering with the cheap and plentiful supply of fish. This Commission introduced scientific investigations into the inquiry for the first time, and, mainly through the influence of Lord Dalhousie, a small marine laboratory was established at St. Andrews at the beginning of 1884, and was useful in preparing the scientific Report. Much evidence was laid before the Commissioners strongly condemnatory of trawling—as destructive to the spawn of fishes, the grounds they frequented, to the fishes themselves and their young, and to the lines and nets of the fishermen.

The Commissioners, while noting (from the evidence) a falling off of flat-fishes in territorial waters from the Moray Firth to Grimsby, and a diminution of Haddocks in certain places, found no decrease in the total catch of fishes in the North Sea, except in the case of Soles. Further, that the beam-trawl is not destructive to the spawn of the Cod and the Haddock, or other edible fishes, nor does it cause wasteful or unnecessary destruction to the immature food-fishes. It has not been proved, moreover, that it is the sole cause of the diminution of fish in territorial waters.

Here, then, another Royal Commission was clearly not satisfied as to the supposed widespread diminution of food-fishes in our waters. The Commissioners recommended the creation of a Central Authority for the Fisheries of Great Britain, if not of the United Kingdom; that in the meantime the powers of the Fishery Board for Scotland be increased; and that statutory powers be given to collect statistics—besides various minor recommendations. One of the most important steps, however, followed, *viz.* the closure of certain inshore areas, and the carrying out of experiments therein—as recommended in the scientific Report.

As the scientific Report was the first of its kind, special instructions had been drawn up for the guidance of the reporter. Thus the observations were to be made on board commercial trawlers upon the grounds they frequented at the different seasons. Special note was to be taken of the proportional quantity of immature food-fishes at various seasons; of the destruction of the spawn of food-fishes; and of the proportion of living and dead fishes brought on board. Other points were the breeding of fishes, the temperature of the sea, and the sedentary and pelagic fauna of the fishing-grounds.

The scientific observations—just alluded to—in trawling vessels on the various important fishing-grounds off the East Coast had this not unimportant feature, *viz.* that they were all carried out under the same eye and by the same hand on sea and on land. Moreover, a simple method of dealing with the food-fishes captured was adopted, *viz.* a division into "saleable," "immature," and "unsaleable": yet this division rested on a size-limit. It has to be remembered, however, that it was not the scientific observer who regulated the size of the "saleable" fishes, but the fishermen, who knew the demands of the public; and the same principle was followed in reviewing the subsequent experiments of the Scotch Fishery Board's ship 'Garland.'

This scientific Report gave an account of beam-trawl fishing, and the kinds and proportions of the saleable and unsaleable fishes, the proportions of the living and the dead, and of the immature fishes; the development and growth of the food-fishes, and the universal presence of floating eggs in all the ordinary food-fishes, except the Herring and the Wolf-fish. It showed that no noteworthy destruction of the spawn of food-fishes

occurred; that the small or immature fishes (in the deeper water) consisted chiefly of Dabs and long rough Dabs. It gave the distribution of the food-fishes on the various grounds, and the relative position of the districts; lists of unsaleable fishes (chiefly Frog-fishes); the fauna of the trawling-grounds, surface and bottom; food of fishes; temperature of the air, temperature of the surface- and bottom-water, besides other points, such as the satisfactory condition of the fishes themselves; and the effects of frequent hauls of the trawl on the same ground.

It demonstrated that the inshore was dependent on the offshore for the supplies of eggs and young of various fishes, *e.g.* Plaice and Turbot, and that a gradual passage of the eggs and young shorewards, and of the growing fishes at a later stage seawards, took place. Thus legislation confined to one area might not be followed by much benefit. It showed that in a small bay like St. Andrews, constant and long-continued trawling did not exhaust the fishes, and that the local men almost invariably kept to the same line in their operations—a state of matters which the history of the Brixham trawlers substantiated. Finally, that there was no proof of such serious diminution of food-fishes as to lead to extinction, or that the actual facts, when carefully considered, should conduce to anything else than vigilance. The condition, indeed, was such that hesitation was felt in interfering with moderate freedom in well-conducted modes of fishing. The Report also recommended the establishment of experimental hatcheries of sea-fishes, the closure of certain areas for experiments, and the keeping of records by all fishermen, showing the ground, weather, depth of water, and the nature of the fishes caught.

From the earliest stage of the inquiry Lord Dalhousie was struck by the absence of reliable statistics, and he immediately took steps to remedy this condition in Scotland. His personal influence and initiative, indeed, have placed Scotland in advance of England in this respect.

After presenting his Report to Parliament, Lord Dalhousie requested the scientific reporter to draw up a scheme for the experiments in the three areas selected for closure, *viz.* the Forth, St. Andrews Bay, and Aberdeen Bay; and the Chairman of the Scotch Fishery Board and its scientific member also visited

St. Andrews for details, so that the fullest information was at the Board's disposal. Unfortunately, as it proved, the Board deviated from the advice given in regard to ship, staff, and apparatus, as well as in the regularity of the experiments in the closed areas, though, it is right to add, this may have been partly due to lack of funds.

The Scotch Fishery Board thus entrusted by the Government with the important duty of carrying out the scientific experiments —experiments which were to form the basis for future fishery legislation—had recently been constituted (1882), and had begun to interest itself in scientific questions—such as the spawning of the Herring. Many would have thought that it would have thoroughly sifted this intricate subject in the closed areas before proceeding to avail itself of the increased powers the Secretary for Scotland (Lord Dalhousie) had obtained for it. The death of Lord Dalhousie, who always kept himself in touch with the proceedings of the Board, seems, however, to have loosened the hands of the members. Having just commenced the trawling investigations in the areas, and before any reliable result could have been obtained, the Scotch Board closed a considerable area in the Moray Firth, being "of opinion that valuable scientific results might be obtained if beam-trawling was restricted in the district." Moreover, while releasing Aberdeen Bay, it would appear somewhat hastily, the Board increased the closed areas in the Firth of Forth and St. Andrews Bay.

Subsequently, the work of two summers in the closed areas—with an inefficient ship, and with observers new to the duties—was sufficient to make the Board forgetful of the labours of Lord Dalhousie's Commission and its injunctions, for it appointed a Committee of its own members to form an independent judgment on trawling and the closure. After inquiries held at various fishing centres in Scotland, this Committee presented a Report on the subject to the Secretary for Scotland (Sir G. Trevelyan) in May, 1888. Whilst no one would have wished to cramp the energies of the Board in this or any other inquiry, the methods adopted were open to criticism. It is also probable that this inquiry would not have happened if Lord Dalhousie had been Secretary for Scotland. Their experimental ship had, as mentioned, only searched the seas for two summers, when, misled by

the high averages of captures (for last season's work had been done in the warmer months), this Committee recommended the closure of the Firth of Clyde, and the territorial waters between Red Head and Kinnaird Head, and they were closed in 1899, because "they were satisfied that within the area to which this bye-law applies (*viz.* between Red Head and Kinnaird Head) beam-trawling as a mode of fishing is injurious to the sea-fishings." The Herring Fishery Act of the same year (1899) was the signal for closing the whole of the Scottish waters within the territorial limit. Still further closures occurred in 1890, when the Moray Firth from the Ord of Caithness to Craig-head was shut against trawlers, the primary object, it was stated by the Board, being to prevent the capture by trawlers of immature fish, which exist in large numbers in the area closed.* The entire Moray Firth, again, was closed in November, 1902—(1) "to protect the fishes on their spawning-grounds (*e.g.* Smith Bank), and to ascertain the extent to which such measures are likely to be beneficial to the fish supply"; and (2) "in view of the repeated petitions from the line fishermen in the Moray Firth, and from a belief that trawling was really a source of injury to the fisheries there."†

Whatever basis, social or political, this action of the Scotch Board (and the Scotch Secretary) may have had, it cannot be said that it rested on a reliable scientific foundation. The supposed protection of the spawning areas in the Moray Firth was and is unnecessary, either in regard to the adults or their floating eggs and young. The spawning fishes—both round and flat—occur beyond the closed area of the Firth, as well as within it, for fishes respect no imaginary lines, and between them place the safety of the food-fishes beyond question. Lately much prominence has been given to the influence of the offshore on the inshore areas, as if such were a new feature, but this was clearly pointed out in the scientific Trawling Report of 1884, and, when studied, will give little countenance to the closure of Moray Firth on scientific grounds. Besides, no report of the scientific results gained by the closure of this area has yet been placed before the public, unless it be the following‡:—"The quantity of fishes

* Ninth Ann. Rept. S. F. B., p. xl. (for 1890). 1891.
† Eleventh Ann. Rept. (for 1892), p. xlix. 1893.
‡ Eighteenth Ann. Rept. S. F. B., part iii. p. 7 (for 1899). 1900.

procured by the 'Garland' is therefore small, and furnishes a most inadequate basis for any conclusions as to the effect of the closure of so wide an area as the Moray Firth." There is little satisfaction in this, especially as the Board was to show—by the closure of such offshore waters—how the spawning fishes which supplied the inshore with eggs and young could be protected. Moreover, so far as known, the proofs of the injurious effects of trawling on the fisheries have not yet been demonstrated by the Board. The idea that the eggs of the fishes of the Moray Firth supply the eastern shores of Scotland and the offshore is chimerical. Besides, both are independent of such supply.

Science, therefore, declines responsibility for such a closure, for, as will subsequently be shown, it is satisfied that the closure even of small areas is not followed by an increase of fishes, and that the supply of eggs and young may be altogether independent of such closure.

No one will, however, deny the right of the Government to close an area for the protection of the lines and nets of fishermen should they be constantly destroyed by trawlers, and it has to be remembered that about ten thousand fine fishermen frequent the shores of the Moray Firth. Nor would exception be taken if it were proved that such a measure was indispensable for the existence of these fishermen. But such grounds must be frankly stated and openly upheld. No thin veil of so-called science should obscure them.

Before entering into the consideration of the results of the ten years' experiments of the Scotch Fishery Board's ship 'Garland,' it is necessary, in sequence, to notice a Parliamentary Committee of seventeen members (with Mr. Marjoribanks as Chairman) in 1893, and which with great promptitude presented a Report within five months of its appointment. This Committee had the advantage of the statistics collected by the Board of Trade, and by the Scotch Fishery Board, and of the evidence of scientific men of experience in the fisheries. The Committee reported no falling off in the Herring fishery, that the Cod and Haddock fishery required no legislation, but that the flat-fishes —especially Soles and Plaice—had diminished, and that a size-limit (eight inches for Soles and Plaice, and ten inches for Turbot and Brill) should be fixed; further, that the three-mile limit

should be extended, and that an English Sea Fishery Board should be established—besides other and minor recommendations.

It is important to bear in mind, however, that a considerable part of the scientific evidence was founded on the statistics of scientific trawling as furnished by the Scotch Fishery Board. Now, as will by-and-by be shown, these data were not reliable. The faulty method of handling them had led to the view that the flat-fishes were decreasing.

The search of the 'Garland' along certain specified lines in the closed areas, and in the sea immediately beyond, for the long period of ten years can only be briefly dealt with here. It has been exhaustively studied elsewhere, and in a similar manner to the original trawling experiments in 1884, with the result that this costly but interesting scientific work showed that there was no striking increase in the fishes of the closed areas, but, on the contrary, that the fish-fauna stood at the end very much as at the beginning. It is true the Scotch Board considered, as already indicated, that there was a decrease of flat-fishes (especially Plaice), caused, it was thought, by the destruction of the spawning Plaice and other forms by trawlers outside the closed areas, but it has been shown that this arose from a misapprehension. The Board, indeed, contrasted the first five years' work—in which the trawling was done in a larger proportion of warm months—with that of the second five years, in which the trawling was done in a larger proportion of cold months. The conclusions arrived at were equally erroneous with the earlier notion that a great increase of fishes had occurred in the closed areas, but it strengthened the Board's supposition that the decrease in flat-fishes was due to the destruction of the spawning fishes beyond the limit. This view, moreover, formed an explanation and a justification for the closure of such an area as the Moray Firth. Long observation, however, has shown how futile such imaginary protection is in so small a bay as St. Andrews. How much more futile in the case of the vast area of the Moray Firth.

The experiments of the 'Garland' in the closed areas, and continuous observation in St. Andrews Bay and elsewhere—*viz.* on both sides of Britain from Shetland to the Channel Islands—in everything pertaining to marine life, have gradually formed

more rational views of the fisheries. No bay, for instance, is better known to men of science than St. Andrews Bay, which has been fished from time immemorial. It is probably about one hundred years since an elementary kind of trawl was used in its waters, and more than forty years since a fleet of local sailing trawlers swept it more or less every year. Moreover, ten or twelve steam trawlers also worked it for some years—before the closure for the scientific experiments of the 'Garland' in 1886—when it was said to be "trawled out." Yet, on the cessation of trawling, there was no lack of fishes, and especially of flat-fishes. Further, it is a remarkable fact that the fleet of local sailing trawlers worked, weather permitting, invariably in the same line, by well-known land-marks; thus for more than thirty years setting at naught the fears of those who make a nightmare of "trawling out," and of "barren areas" of the sea. Such, indeed, might have been expected from the longer and more continuous experience at Brixham.

Notwithstanding the lamentable accounts of the condition of St. Andrews Bay as shown in the evidence before Lord Dalhousie's Commission in 1883, its fishes, scientifically examined in 1884, were very much as they are at this moment. Careful observations since that date have demonstrated that in their season, and by the use of anemones for bait, and then of gill-nets, Cod (said to be so rare) can be caught in hundreds by a single boat; that for a space of two years at a time (1905–1906) enormous numbers of saleable Haddocks may swarm in the bay, unaffected by the busy steam trawlers outside the limits; that the larger Thornbacks (a kind of Skate) are and have always been plentiful, and of the same size; and that much that has been said about the diminished size of the perennial Plaice needs modification, for in such a shallow sandy bay few mature fishes normally occur, only multitudes of young forms, which as they increase in size pass outwards to the deeper water—as of old. Further, the gill-nets demonstrated not only the abundance of food-fishes, but of numerous large Sharks (Porbeagle, nine feet), and many Porpoises, which would otherwise have been unknown, and every one of which levied daily contributions from the food-fishes.

All this plenitude has been retained, though the number of

men and boats has increased from six or seven yawls, with five men, to twenty-one modern boats, of treble the size, and with all the new appliances, so that six or seven men suffice. Besides, Broughty Ferry and Arbroath send a large contingent.

The work of the 'Garland' in the closed waters of St. Andrews Bay and other areas will probably long remain unique, for it is unlikely that such a series of observations, continued over ten years, will ever again be made. With all the faults arising, amongst other things, from the small size of her trawl (25 ft.), and her unfitness for the rough seas of the eastern coast, the observations made by the aid of this ship have been noteworthy, and useful, by way of contrast, with those made in 1884. The results have corroborated the view that the marine food-fishes are able to withstand man's interference. By its aid, more or less, the rate of growth of fishes, the size and age at which maturity occurs, the fecundity of fishes, period of spawning, distribution of fishes—adult and young—and other features have been considerably advanced. Even Dr. Garstang, the author of a paper on the "Impoverishment of the Sea," observes:—"I am satisfied that the experiments have been largely successful in throwing light on the problem which they were designed to elucidate, in spite of the unfortunate errors of method with which the conclusions have been associated."

It is eleven years since the 'Garland's' experiments in St. Andrews Bay have ceased, and it is therefore quite fair now to ask, with reference to the supposed diminution of Plaice in it, where and when this has occurred? The introduction of Plaice-nets alone gave this notion a short shrift, not to speak of the swarms of tiny young along the tidal margin every spring, and of those of larger size all over the bay. The uncertainty, moreover, of relying on one line of investigation is shown by the fact that, at certain seasons, few or no Plaice can be caught in the gill-nets, whilst Dabs are abundant; but if hooks baited with lobworms are scattered on the same ground—from which some suppose the Plaice have "migrated"—a good supply will be obtained.

Since the publication of the 'Resources of the Sea,' in which the details of the experiments in the closed areas are dealt with, a Select Parliamentary Committee, under the presidency of the

late Mr. Ritchie, was appointed in connection with the Immature Fishes Bill. It reported a diminution of flat-fishes in the North Sea, probably due to the destruction of immature fishes. The Bill, however, was rejected.

Lastly, the Committee on Ichthyological Research appointed by the Board of Trade sat in 1901, and made various recommendations of importance in regard to improved statistics, increase of steamers for scientific work, establishment of a scientific department at the Board of Trade, a national Fishery Museum, and a co-ordination of the various administrative and scientific bodies.

At this stage it would be well to retrace our steps to 1883 —*viz.* the commencement of the scientific period—in order to review another phase in the scientific treatment of the fisheries. At this time (1883) the floating or pelagic condition of the eggs of the sea-fishes was almost unknown to scientific men in this country, though Prof. G. O. Sars, of Norway, about twenty years previously, had shown hat the eggs of the Cod, Haddock, and Gurnard were pelagic, and others had subsequently added the eggs of the Pollack, Bib, Pilchard, Mackerel, Flounder, Dab, and Plaice to the same category. No attention had been given to the subject in Britain, the most eminent men, indeed, believing that the floating or sinking of such eggs might be due wholly to the temperature of the water; whilst others deemed that the buoyancy was caused by the oil-globule, overlooking the fact that many were without such. As the investigations for the Trawling Commission advanced it was found how universal this pelagic or floating condition was. Moreover, steps were at once taken to put our knowledge of this important subject on a more creditable basis by constant observations with nets (including the large triangular midwater and bottom net of 10 ft. bars*), trawls, scrutiny at low water-mark, and by the co-operation of liners and trawlers. Now this country is, to say the least, not behind any

* We read of a "new era" in fisheries' work being inaugurated the other day by the use of a *square* net of this description. The era will have to be antedated by twenty years at least. Dr. Nansen took one of the St. Andrews nets to Greenland. They can be used at any depth, the finest hauls of young fishes of all kinds being obtained about a fathom above the bottom—say, in twenty to thirty fathoms of water. For inshore flat-fishes another form, like a beam-trawl, is employed.

other in its knowledge of the reproduction, the development, and the life-histories of its marine food-fishes. Whilst St. Andrews took the lead in this work, it is only fair to say how ably the Laboratory at Plymouth exerted itself amongst the southern fishes, and the scientific staff of the Scotch Board amongst the northern fishes.

Very early in these inquiries it was shown how easy it was to hatch the pelagic or demersal eggs of every sea-fish, even though they had to be transported from Shetland or the middle of the North Sea. A lecture on the subject, indeed, was given in the Royal Institution in 1889. This brings us to one of the recommendations of Lord Dalhousie's Commission, *viz.* that experiments should be instituted to test the possibility of augmenting certain valuable sea-fishes by artificial hatching of their eggs. Much had been said to the Commission about the success of the Americans in this department, and the picture thus sketched was supposed to be somewhat discreditable to our country. In view of the importance of the subject the Scotch Fishery Board made inquiries in Norway, where Capt. Dannevig had hatched Cod in large numbers for some years, had a duplicate of his hatching-house and boxes made under his supervision in that country, constructed a concrete tank, various enclosures of the sea, and started a hatchery at Dunbar in 1892 under the management of Dannevig's son. The fishes selected for experiment were Cod, Plaice, Lemon-Dabs, Soles, and Turbot. In 1899 the hatchery was transferred to Aberdeen. For fifteen years the Board has continued the operations, and has endeavoured to test their value by stocking—*e. g.* with young Plaice—such areas as the upper reaches of Loch Fyne and Loch Gair. Unfortunately, no definite general result appears to have been obtained, for none has been published. Probably a considerable amount of time was lost from inexperience in the early efforts, but after the lapse of fifteen years' expenditure the country has a right to know the result. Hatching operations have likewise been carried on at Piel, in Lancashire, by the North-Western Sea-Fisheries Committee, under Prof. Herdman, but here also evidences of their practical influence on the sea-fisheries are wanting. In France considerable success has attended the efforts of M. Fabre-Domergue* to rear to the length of 12–15 mm. Soles, but the

* 'Développement de la Sole.' Paris, 1905

experiment is on a small scale, and, in view of what takes place in the nets of the shrimpers, could not materially affect the situation.

Allusion has been made to the work of the United States Fish-Commission, which for nearly thirty years has carried out extensive experiments in sea-fish hatching. Yet, though Prof. Baird noted that small Cod of the grey or offshore variety (that used in the hatchery at Gloucester, Mass.) appeared in the harbour next year, where they never were found previously, and larger forms of the same variety in the two following years, no absolute proof is forthcoming, even up to date. It is true the American Fisheries Bureau* claims that there has been a general improvement in the shore-fishery for Cod, and that this improvement has been to some extent cumulative since the operations commenced at Woods Holl and Gloucester, and that the increase followed the line of the adult fishes which were marked and set free after spawning. Even though hundreds of millions of fry of Cod and Flounders have been placed in the sea by the Americans, Mr. Fryer, one of H. M. Inspectors of Fisheries, holds that marine fish-hatching is immaterial, since there are so many young forms in the sea. Similar views are held by Petersen, of Denmark, who considers that it is of no consequence whether Plaice spawn in the Lim Fjord or not, as enormous numbers of small Plaice exist in the free waters outside, and migrate into it. Even the long-continued labours of Capt. Dannevig, who for many years has turned the artificially hatched Cod-fry into the fjords of Norway, are held to be useless by Dr. Hjort, Dr. Knut Dahl, and others in that country. Similar remarks apply to the great hatchery for Cod at Dildo, Newfoundland.

The enormous powers of reproduction of the sea-fishes, their pelagic eggs, the wonderful passage of the larval and post-larval fishes shorewards, or otherwise, according to definite laws, which are altogether independent of currents or temperatures, and their migrations outward to deeper water as they grow older, place them in a wholly different category from fresh-water and anadromous fishes—even without considering the marvellous and

* I am much indebted to Dr. Goode Brown for valuable information on this head.

unbroken chain of those organisms—from diatoms to fishes*—which form their food at every stage.

On the whole, the conditions under which the adults of sea-fishes are kept for the artificial supply of eggs are not always favourable for health, and a comparatively small number of such adults in the open sea would produce a much greater number of healthy young. Besides, there is no lack of young fishes in the ocean.

The whole history of the sea-fisheries of our country, from the earliest period up to date, thus affords no solid grounds for the pessimistic views either of scientific or practical men. It has not been proved that our seas have been depleted of food-fishes to a dangerous extent by man. In pre-statistical times the out-cry was as loud as now, even though the captures were small. After statistics were established, the complainers fixed on certain fishes, such as the nomad Cod and Haddock, till it was demonstrated that their fears were groundless. Then the flat-fishes (supposed to be sedentary) were singled out, and persistently held up—even now—as forms which were diminishing year by year before the hook and trawl. The public are thus constantly harassed by uncertainty and foreboding, whilst the legislature is ever invoked to satisfy one or other group of the pessimists. As Sir Spencer Walpole says, it is the old cry of "wolf, wolf," and yet the wolf has not come during all these years—it might truly be said, centuries. We know that, whitebait notwithstanding, the soundness of the position of the Herring, which furnishes so large a share of the total annual catch, is beyond cavil, and has long been so, and that the round-fishes, such as the Cod and the Haddock, have, though grudgingly, been admitted to be safe—both by their abundance in the market, and the vast areas over which they and their young are distributed. The flat-fishes, such as the Turbot, Sole, and Plaice, possess, not only in the early condition, but throughout life, a protection which few round-fishes (amongst these the Sand-eel and Sting-fish) have, *viz.* the habit of living on the surface of, and often covered by, the sand. Moreover, the number of the pelagic eggs of the first named is enormous, *viz.* about ten millions. In their earliest (larval) condition they are, it is true, pelagic like their eggs, but

* Lecture, Roy. Instit. of Great Britain, Friday, Feb. 1st, 1889, p. 10.

they soon gravitate to the bottom as the eye joins its neighbour of the opposite side, meanwhile approaching the margin of the tide, where they may be found in numbers amidst the muddy sand of the beaches, and where they are comparatively safe. During growth they are constantly shifting from the shallower to the deeper water, where the adults are found. Thus, while the adults may suffer from trawl or hook, their places are filled by an ever-constant stream of young—in the case of Plaice—in such numbers that hitherto their extermination has defied man's most elaborate ingenuity and far-reaching cupidity.

Bear in mind how often the approaching extinction of this and that fish has been predicted—how the fishery for Soles, for instance, has had its days numbered about a quarter of a century ago, even by scientific men, it may be, out of touch with the sea. Yet what does Nature teach us in the estuary of the Thames? For five or six hundred years at least the limited area of this estuary has been persistently and almost daily fished for Shrimps by man, and his nets have simultaneously captured and killed, amongst other fishes, numerous young Soles (and I have to thank Dr. Murie for his genial aid in the expedition to secure them)—tiny wafers which are blown on the gunwale of the boats, to which they adhere, in sifting; whilst the larger examples, at various stages, are picked out with the *débris*, and, as a rule, also killed. Since the area referred to has been calculated to send daily to London at least two thousand gallons of Shrimps,* the drain on these young fishes is enormous; yet, it may be asked, has it affected in any marked manner the prevalence of the adult Soles throughout these centuries, and, moreover, has the sea been impoverished in regard to Shrimps? Mr. Shaw Lefevre (now Lord Eversley) has recorded a case where, in Morecambe Bay, a far greater destruction of young flat-fishes was caused by the drying up of the shallow pools between tide-marks by the sun than by all the local shrimpers, of which the flounder-fishermen complained. The fishermen, however, had a ready rejoinder when this was pointed out by the Commissioners, *viz.* that the natural loss was allowed for by Providence, but not that caused by shrimping. It must not, however, be supposed that this wholesale destruction of young fishes is treated with in-

* Mr. Spencer Walpole, Fish. Exhib. Lit. vol. i. p. 47, 1884.

difference, or allowed to go on if it could be avoided. It is only cited as a proof of the wonderful resources of Nature, which for so long a period has maintained supplies in spite of the constant drain—natural and artificial.

A noteworthy instance of the supposed extinction of a food-fish, again, is to be found in the American Tile-Fish (*Lopholatilus chamæleonticeps*).* This fish was discovered in 1879, in deep water off the United States, when fishing for Cod and Hake with "trawls," each about one mile long, and having one thousand hooks, and was caught in considerable numbers. In March and April, 1882, vessels entering the Atlantic harbours of the United States reported that they had passed through countless numbers of dead Tile-Fishes while crossing the northern edge of the Gulf Stream, the mortality being estimated at 1,438,720,000. For ten years no trace of the Tile-Fish was found, but again in 1892, and the following four or five years, some were caught, and in 1898 a large number were captured by an expedition sent to their special grounds, the bait being Mackerel. Prof. Verrill thought that the destruction of the Tile-Fishes was due to the effects of a great storm, which lowered the temperature of the warm slope they inhabited. Their reappearance was connected, by Prof. Libbey, with the movement of the warm band of water towards the shore, which thus restored their former environment.

Nor do the foregoing facts stand alone. A perusal of the English and Irish statistics, and still more of the Scotch official returns, which are at once the oldest and most complete, will show the soundness of the position. One instance will suffice: In 1897, the last return dealt with in the 'Resources of the Sea,' the grand total of the Scotch fisheries was 5,001,672 cwt., of the value of £1,627,752. More or less steadily have these fisheries mounted up, till in 1905 (the last published Report) the grand total (exclusive of shell-fishes) reached 7,856,310 cwt., or 2,854,638 cwt. more than in 1897, whilst the total value was £2,649,148, or considerably above a million more. So far as can be observed, therefore, and taking all the circumstances of increased means of capture into consideration, the result is not disquieting. Moreover, countries which began in fear—like the Americans—to spend large sums on the sea-fisheries, now find

* Dr. H. C. Bumpus, Bull. U. S. Fish. Com. vol. xviii. p. 321, 1898.

that there has really been no general reduction in prosperity, notwithstanding the development of modern methods and the vast increase of population.* The same may be said of the Lofoten Cod-fisheries of Norway, which for one thousand years have shown no diminution; of the perennially abundant Cod-fisheries of Newfoundland; of the vast fisheries of Canada (under the scientific guidance of Prof. Prince, of St. Andrews), which during the last thirty years have steadily maintained, if not exceeded, their pristine value. Even the Lobster (by some regarded as a vanishing form) began in 1875 with 1,638,658 dollars, and ended in 1905 with 3,906,998 dollars, the canneries and traps having increased ten and one hundredfold respectively. Yet in the most rigorously fished area (Western Nova Scotia) there was an increase in 1904 over 1902 of 196,316 dollars. If a comparatively sedentary animal like the Lobster, which carries a limited number of eggs for many (eight to eleven) months, can survive, and even multiply, under such severe conditions, how much more fitted for endurance are the food-fishes, with their far greater number of floating eggs, their wonderful life-histories, and surroundings in an element so vast and so conducive to safety.

VALUE OF CATCH (IN DOLLARS) OF IMPORTANT CANADIAN FISHES. THIRTY YEARS.

	Cod	Haddock	Hake	Mackerel	Lobsters	Oysters	Herring
1875	3,249,000	282,385	152,756	1,245,570	1,638,658	12,000 barrels	1,377,175
1880	3,900,000	626,300	656,894	1,181,000	2,843,100	64,646 barrels	1,233,000
1885	4,302,454	785,245	217,981	1,826,681	2,351,559	50,540 barrels	2,645,447
1890	3,449,640	532,068	440,064	1,958,492	1,648,348	61,032 barrels	2,294,914
1895	3,638,519	444,703	210,856	736,655	2,210,096	47,673 barrels	2,800,556
1900	3,614,775	608,067	520,504	1,549,448	3,055,350	41,920 barrels	1,853,237
1905	3,421,400	806,743	447,665	985,223	3,906,998	34,449 barrels	2,303,485

* In Japan, likewise, boats are increasing in number as well as in equipment, and though Prof. Kishinouye thinks inshore fishes have decreased, yet the absence of reliable statistics shows that Japan is only passing through the experience of all old countries.

So long as the countless hosts of the young of the round-fishes, like the Cod and the Haddock, people vast areas of the open sea, regularly appear off our rocky shores, or fill the great midwater- and bottom-nets in deep water, or, like the newly-hatched Herrings, form a carpet on the sandy bays ; so long as swarms of the young of the flat-fishes frequent the tidal margin on sand or sandy mud, and are scattered, at a somewhat older stage, broadcast over our sandy bays ; so long as the fishery statistics, not only of Britain, but of all the countries bordering the North Sea, show only the usual fluctuations of an uncertain pursuit, or point to an increase ; so long as the calm survey of the whole subject is as satisfactory as at present, it would be neither scientific nor practical to doubt the permanence of the marine food-fishes, or the marvellous resources of Nature in the sea.

Such, then, is a brief and imperfect outline of the facts which make it clear that the British fisheries, notwithstanding all the restlessness and distrust of the fishermen and the public, and notwithstanding all the fears of the learned as to man upsetting the balance of nature, are, upon scientific grounds, not unsatisfactory. The larger fishes on a given area may, by constant work, be diminished, and the rest rendered more wary, but the ranks are soon filled up by the younger forms. When we come, in the following part, to consider the international statistics and observations—though some of these are from the hands of those who began the work imbued with the popular notion of the 'Impoverishment of the Sea'—it will be interesting, after their unequalled opportunities and unequalled expenditure (of £70,000), to discover how far such a view has been substantiated.

AQUATIC COCKROACHES.

By R. Shelford, M.A., F.L.S.

In 1897 the writer was collecting insects on a mountain close to Kuching, the capital town of the State of Sarawak, in Borneo, and, whilst examining a small pool at the base of a waterfall for water-beetles, discovered several Cockroaches lurking in the sodden leaves scattered about the edge of the pool. The insects, when disturbed, took to the water, and dived to the bottom, where they hid under sticks and stones. The habit was sufficiently remarkable and unexpected to deserve further investigation, and several specimens were captured alive, and placed in a glass tank with some water and an abundance of vegetable *débris*. All the specimens were immature, and of varying size, ranging from 10 millim. to 25 millim. in length. It was observed that they could not endure total immersion in water for any length of time; if a specimen was confined in a tube full of water, and denied all access to air, it would struggle violently for a few minutes in its efforts to escape, and then sink to the bottom of the tube, and there expire. This is what one might expect from the results of certain experiments conducted by Prof. Plateau, of Ghent, on the relative staying powers of land- and water-insects when totally submerged in water. The distinguished Belgian entomologist found that, whilst terrestrial insects will support an immersion for a period ranging from $97\frac{1}{2}$ hours to $22\frac{1}{4}$ hours, aquatic beetles succumb in periods ranging from $65\frac{1}{2}$ hours to 3 hours. The aquatic Cockroach drowns even more rapidly than aquatic beetles, and it was found that a terrestrial Cockroach, though enduring total immersion for a few hours, is unable to remain alive without air for even the minimum time recorded for terrestrial beetles.

The aquatic Cockroaches that were kept under observation were very inactive, resting for hours at a time on the dead leaves with which they were provided; generally the front part of the

body was in the water, but the tip of the abdomen was never submerged, even when all the rest of the body was covered. The abdomen moved up and down with a rhythmic action, and bubbles of air issued at more or less regular intervals from the prothoracic spiracles. These air-bubbles were seen to form gradually, to grow larger and larger, and finally to break away from the spiracles; about twenty per minute passed through the spiracles. Air issued from the mesothoracic spiracles only when the insect was violently agitated. From these observations it seemed fairly obvious that the terminal abdominal spiracles were inspiratory in function, the thoracic spiracles expiratory, and that it was necessary, therefore, for the insect to have the tip of the abdomen exposed to the air, but that it was a matter of indifference whether the expiratory spiracles were above water or below it. In order to settle the question beyond all manner of doubt, some specimens were fastened with cotton threads to strips of cork; half the number were fastened head downwards, the other half head upwards. The cork-strips with the attached insects were then immersed in tubes of water. In the case of the reversed specimens the water covered the thorax and basal segments of the abdomen, but the tip of the abdomen projected above the water-level; the other specimens had the abdomen in the water, but the thorax exposed. The results in every case proved the inspiratory and expiratory functions of the abdominal and thoracic spiracles respectively. The reversed specimens endured their constrained position for many hours (twenty-four to forty-eight or more), and when released seemed little the worse for their experience. On the other hand, the specimens with the abdomen immersed in water died in less than twelve hours, sometimes in less than six. The structure of the thoracic spiracles in Cockroaches is quite different from that of the abdominal spiracles,* and a difference in function is only to be expected; nevertheless, when repeating these experiments with terrestrial Cockroaches, such as *Panesthia javanica*, I was unable to demonstrate satisfactorily the functional differences of their spiracles. This failure may be accounted for—in part, at any rate—by the fact that this species struggled long and violently when pinioned to the cork-strips, and, as they are extremely muscular insects,

* Miall and Denny, 'The Cockroach,' 1886, pp. 151–155, ff. 85–88.

their bonds had to be tightly fastened in order to keep them in position; even then the prisoners did not relax their efforts to free themselves, and I believe that they died of exhaustion and of injuries sustained in their struggles rather than from drowning. The aquatic species, on the other hand, remained comparatively quiet; the reversed specimens, being fastened in a position more or less natural to them, and being able to obtain their supply of air in quite a normal and usual manner, were very little dis-

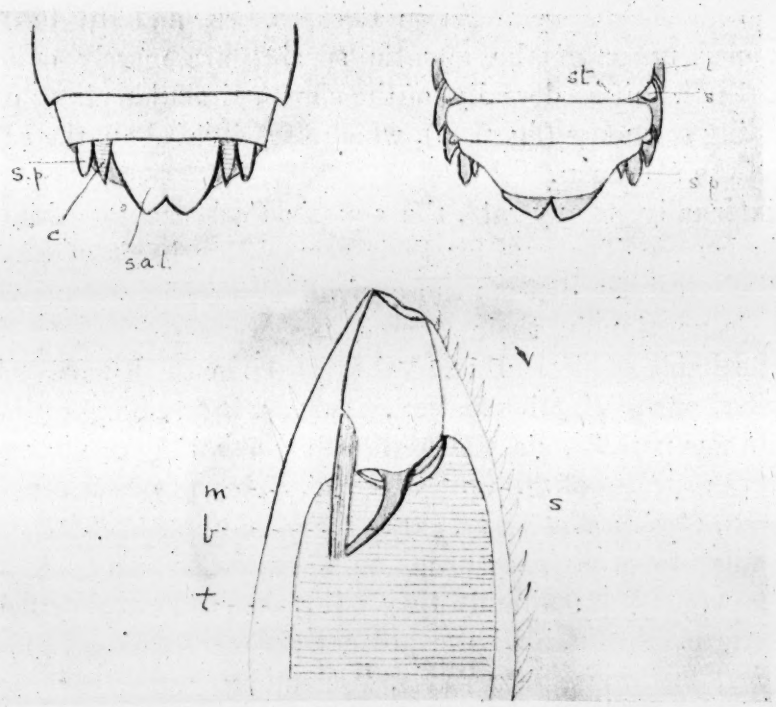

FIG. 1.—End of abdomen of a larva of *Rhicnoda natatrix*, sp. n., dorsal view; *s.p.* spiracular tube; *c.* cercus; *s. a. l.* last dorsal tergite.

FIG. 2.—The same, ventral view; *st.* abdominal sternite; *s.* spiracle; *t.* abdominal tergite.

FIG. 3.—Spiracular tube, highly magnified, seen in optical section; *v.* vestibule; *s.* spiracle; *m.* muscle working *b.*, the chitinous bow; *t.* trachea.

tressed by their bonds, and the other specimens were soon reduced to a comatose condition by the difficulty of obtaining air. The terminal spiracles of these aquatic Cockroaches are situated at the base of two tubes visible on the dorsal side projecting from below the seventh tergite, and external to the anal cerci (fig. 1).

This same feature may be observed in many terrestrial *Blattidæ*, so that it cannot be regarded as associated with the aquatic habit. A microscopic examination of one of these spiracular tubes reveals the following features (fig. 3). The orifice of the tube leads into a short vestibule (*v.*), the vestibule joins a large trachea (*t.*), but intervening between vestibule and trachea is the spiracle (*s.*), a narrow slit in a diaphragm; the slit is opened and closed by the action of a chitinous bow (*b.*), worked by a muscle (*m.*) attached to the wall of the vestibule. This is essentially the structure of all the abdominal spiracles in Cockroaches, and the terminal spiracular tubes of the aquatic species are merely enlarged equivalents, shifted dorsally, of the short spiracular plates of the preceding segments (fig. 2, *s.*), which are situated on the *ventral* side of the abdomen.

Externally, at any rate, the aquatic Cockroaches exhibit no particular modifications for their remarkable habit of life, the legs are not different from those of allied terrestrial genera, and there is nothing in their general appearance to suggest their aquatic habit of life. During the experiments that have been described one distinctive feature, however, in the economy of the insects was notable, *viz.* the ease with which they could remain below the surface of the water. Most adult aquatic insects, e. g. *Dytiscus*, *Corixa*, *Notonecta*, can only keep below the surface by continuing to swim, or by propping themselves under some stone or submerged leaf; directly they relax their efforts they float to the surface. Again, if a large heavy Cockroach, such as *Panesthia javanica*, is thrown into water, it flounders helplessly on the surface, and is quite unable to sink; whereas the much lighter aquatic Cockroach is able to swim, to dive, and to remain submerged with great ease. An explanation of these facts is found if the tracheal systems of the insects are examined. The tracheæ of *Dytiscus* and of *Panesthia* present the usual appearance of opaque silvery tubes filled with air; the tracheæ of the aquatic Cockroaches, on the other hand, are transparent, flattened, strap-like structures, dilated here and there only with air-bubbles. *Dytiscus* and *Panesthia* are buoyed up in water by the plentiful supply of air stored in their bodies, but the tracheæ of the water Cockroach are mere air-passages, not storehouses, the respiratory movements are rapid, causing a constant circulation of air, and

if the supply is entirely cut off there is practically no reserve supply contained in the body to draw upon. Hence the rapid death of the insect when totally submerged; if only partially submerged death supervenes less rapidly, probably because some air can be drawn through the thoracic spiracles. *Panesthia javanica* is able to endure *total* immersion longer than the *partial* immersion to which individuals were submitted, because these individuals, when bound, struggled so violently as to make heavy demands on their reserve air-supply; their position was so constrained, so unusual, and so unnatural that they were not able to "take matters quietly," even when fastened in a position presumably favourable to drawing in a fresh supply. Plateau has shown that aquatic insects drown more quickly than terrestrial insects, and suggests that this is because their supply of oxygen is quickly converted into CO_2 through their violent struggles to escape, whereas terrestrial insects, when submerged in water, soon cease to struggle, and, although they become comatose, they recover power of movement when restored to land. It would be of interest to learn if an aquatic insect such as *Dytiscus* would endure partial immersion, *i. e.* with the tip of the abdomen exposed, as well as the aquatic Blattids.

Dr. Nelson Annandale discovered some aquatic Cockroaches in the Malay Peninsula*; the females were wingless, and rested on floating logs, whence they dived into the water when disturbed; the males were winged, and were seen to rise from the surface of the water, but were never seen to enter it. Dr. Annandale states, moreover, that the egg-cases of this species were found in crevices of the floating logs. If the Malay Peninsula species belongs to the same subfamily of *Blattidæ* as the Bornean species, namely, to the *Epilamprinæ*, this discovery of egg-cases is of some interest, for the *Epilamprinæ* are, so far as is known, viviparous insects, the chitinous ootheca deposited by the females of other subfamilies being represented by a delicate membrane enveloping the eggs inside the brood-sac of the mother. Unfortunately, Dr. Annandale's specimens appear to be lost, so that they cannot be identified with certainty.

Another species has been discovered in Formosa,† and Dr.

* Ent. Rec. 1900, p. 76.

† Shiraki, Ann. Zoolog. Japon. vi. 1906, p. 32, pl. 2, f. 4.

Annandale has found an immature specimen in Chota Nagpur, India.* It remains only to give a name to the Bornean species, which appears to be undescribed. The following description is drawn up from an unique female specimen in the Hope Museum, Oxford, evidently the adult of some of the larval forms obtained. The male is unknown.† The Japanese species has been wrongly referred to the genus *Opisthoplatia*; there is no doubt that it is congeneric with the Bornean species.

Subfam. EPILAMPRINÆ.

Genus RHICNODA, Brunner.

Rhicnoda natatrix, sp. n.

♀. Castaneous. Allied to *R. rugosa*, Br., from Burma and Java, but larger, and with the dorsal segments less rugose. Head concavely depressed between the antennal sockets, this area cribrately punctate, rest of head with scattered punctures. Pronotum just covering vertex of head, arcuate, posterior margin truncate, anterior and lateral margins slightly reflected; a few scattered punctures and a pair of impressions on the disc. Tegmina rufous, exceeding the mesonotum in length. Meso- and metanotum and abdominal tergites slightly and irregularly rugose, the posterior margins of the sixth and seventh tergites plicated. Supra-anal lamina produced, apex emarginate, cerci abbreviated, spiracular tubes short; subgenital lamina ample, posterior margin sinuate, disc transversely wrinkled. Front femora with five spines in middle of anterior margin beneath, four spines on posterior margin; formula of apical spines $\frac{2}{1}, \frac{1}{1}, \frac{1}{1}$, front femora with no genicular spine. Posterior metatarsus equals remaining joints. Total length, 35·5 mm.; length of tegmina, 7 mm.; pronotum, 10 mm. × 17·5 mm.

Borneo (Wilson Saunders collection, Hope Museum, Oxford).

* Jour. As. Soc. Bengal (new series), vol. ii. 1906, pp. 105, 106. Dr. Annandale confirms my account of the respiration of these insects, and noted the ease with which his specimen was drowned when totally submerged.

† In a preliminary account of these Cockroaches (Rep. Brit. Assoc. 1901, p. 689) I stated that they consisted of two species—one an Epilamprine, the other a Panesthiine. This is an error due to inaccurate information supplied to me at a time when my knowledge of the *Blattidæ* was less than it is now. All the specimens collected by me are immature, and are referable to two Epilamprine genera, *Rhicnoda* and *Epilampra*. The females of the former genus apparently lead a semi-aquatic life always. I expect that it will be found eventually that some terrestrial species of *Epilampra* are amphibious or aquatic in their earlier stages.

OBSERVATIONS OF AN ATTEMPT OF THE SWALLOW TRIBE TO WINTER IN SOUTH HANTS DURING 1906–7.

By Harry Beeston.

For several years past I have taken a very deep interest in the migration of birds, both during the spring and autumn, and have noted some extremely interesting, yet withal puzzling, observations on the very late departure of the Swallow family in the South of England.

Havant—the town where I reside—is situated near the sea, the open Channel being only four and a half miles distant, while the waters of Langstone and Emsworth Harbours are within half a mile of the town.

The locality is well sheltered on the north by the South Downs, and by the Isle of Wight to the south ; the atmosphere is humid, and the climate rather mild, even in winter, so much so that frequently gnats and flies are seen hovering over the streams and fields, in abundance, in the middle of winter. During a residence of twelve years in the district I have never seen the streams frozen over.

I mention these facts in order that the following remarks may be better understood ; they have, in my opinion, a direct bearing on the question of bird migration, and may be able partly to explain why Swallows and Martins arrive so early, and linger so long in the locality.

It is more of the *apparent desire of the birds to remain* so abnormally late in the district, than of their early appearance on which I wish to dwell specially, with a view to obtaining some satisfactory solution to the problem.

The fact is well known that members of the Swallow tribe are reported from various parts of the South of England very late in the season (autumn), but Hampshire seems greatly favoured in this respect, year by year, in the neighbourhood of Havant. In the year 1903 Swallows and Martins (two species) lingered well on into November, and a solitary *House-Martin* was seen flying

about, and hawking for food over a stream in the locality, quite near to the town, on *December 30th*. This at the time was thought to constitute a record, but during the following years much later records have resulted. The next year (1904) Swallows (*Hirundo rustica*) remained well on into November, but during 1905 and 1906 the birds remained abnormally late.

First take 1905. Swallows and Martins, in fair numbers, remained on after the general southern exodus was over. Here follow the observations copied from my diary.

On Nov. 18th *six Swallows* and *one Sand-Martin* were observed vigorously feeding, and very strong on the wing. The day was very cold, and a keen N.E. wind was blowing. I mention the direction of the wind as it had been blowing from a *northerly* point (N.E., N.W., or N.) from the 13th inst.; so that the birds had not apparently lingered *because the wind was not in the direction most generally thought to be suitable to migration*. There had been ample time and opportunity for departure.

On Nov. 19th *five Swallows* were observed—two adult birds and three young ones. The wind was still N.E. The Sand-Martin seen on the 18th had disappeared.

The 20th was a bright day, with a cold, raw, frosty air, with wind due north. During the night there had been a keen frost, and the ground was white with hoar-frost. *One Swallow* only was seen—an adult bird. The others may have been in the locality, but were not seen, as the observation was made at dusk, and the birds may have gone to roost for the night.

21st.—*Two Swallows* sporting about to-day, and very strong on the wing, although there had been *ten degrees of frost* during the night; the roads were frozen hard, and the puddles and ditches thick with ice, though the streams were not frozen over. The birds occasionally rested on a wire-fence by the side of the stream, and preened their feathers as though the weather was mid-May instead of winter. The wind was N.W. *One* of the birds noted to-day was *adult*, and the other appeared a young one, and in immature plumage.

22nd.—Sudden change in weather—wind S.W., and a mild showery day. During the night eight degrees of frost had been registered, yet *two Swallows* remained—to all appearance the same as seen yesterday.

23rd.—Wind W., mild and showery. *Two* Swallows hawking vigorously for food over the stream.

24th.—Wind S.W. *One* Swallow seen, and this appears to be the *young* bird, as it has several whitish (or greyish) feathers on the rump, and in the tail.

25th.—Strong S.E. wind. One bird still strong on the wing.

26th.—Fierce gale from S.W., with heavy rain. *One* Swallow braving the blast, though finding great difficulty in beating against the wind up-stream.

27th.—Brighter day. Wind W.N.W. Same bird present (by markings), strong in flight, and seemingly quite at home, and in no hurry to depart.

28th.—Strong squally S.W. wind, with rain. Bird to-day seemed weary, and frequently settled to rest on wire-fence; appeared to find a difficulty in facing the wind.

29th.—Bright day. Wind N.E. Bird feeding as usual.

30th.—Cold, raw day. Wind due S. Bird still present.

Dec. 1st.—Weather bright. Wind N.W. Bird strong on wing.

2nd to 4th.—Fine mild weather. Wind N.E. Bird vigorously feeding and strong.

5th.—Very mild. Wind S. Missed bird to-day for first time. Has it departed or died?

6th.—A changeable, mild day. Wind N.E. Much surprised to-day to find the Swallow back again over the stream, and quite lively. No doubt yesterday the weather had tempted the bird to leave the stream, and go on a foraging expedition farther afield. I was quite delighted to find the bird was still alive, and in its usual haunts.

7th.—Fine day. S.W. wind. Bird very fit and vigorous.

8th.—As yesterday. N.W. wind. Bird flying strongly, and making excursions across the fields away from the water. To-day winter and summer seemed strangely blended, for, while the Swallow was gaily skimming over the surface of the water, the Grey Wagtails from the northern districts were taking short flights, and hovering over the stream for instants to snap up the gnats from the surface, displaying their long white tail-feathers in the action, and then fluttering with a cheery "chiss-up! chiss-up!" to the weedy margin again.

9th.—Wind N.W. No Swallow!

10th.—Sharp rimy frost. Wind N.W. No Swallow!

For several days from this date I have visited the stream, but the bird has not been seen since. Has it at last departed to a summer clime? I doubt it. In my opinion it has either fallen a prey to some predacious bird while on the wing, or a prowling cat has secured it from its roosting-place.

On the 8th, when last seen, it was too vigorous on the wing, and swept over the meadows so full of life and animation that I cannot believe for a moment it died of starvation. I regret its disappearance very much, as I feel almost confident, considering the bird had safely weathered *ten degrees of frost* nearly three weeks before, that it would have stayed on until spring, food being plentiful. But this matter of food and other interesting points I shall discuss later.

I now pass on to last year (1906). Even more interesting than the previous notes are the observations made during the late autumn and winter of 1906-7.

Up to the first week in November (1906) Swallows and House-Martins were common, as is the usual thing here, although not in great numbers, small parties of five or six—no doubt parents and their late broods—being occasionally noted sitting on the telegraph-wires, or skimming over the streams.

I again follow my diary notes:—

Nov. 11th.—Wind N.E. Three *House-Martins* seen.

18th.—Wind N.W. Gale of wind and heavy rain. *Five Swallows* seen circling over the tops of elm trees, evidently on the feed.

25th.—Wind N.W. *Three Swallows*, *two* House-Martins, and *one* Sand-Martin sweeping up and down stream in full vigour.

27th.—Wind W. *Two* Swallows skimming over the water and fields.

28th.—Wind N.W. *Five* Swallows sitting on telegraph-wires, evidently a family party, occasionally flying off together in search of food.

29th.—Wind S.W. Weather very mild. *One* Swallow and *two Sand-Martins* in full flight, hawking over the stream. The two latter are evidently stragglers from some other locality

(northward), and the Swallow probably one of the five seen yesterday; but this interesting fact is worth special note—that *four of the latter* have disappeared with a N.W. wind, and the two Martins have arrived; but why *should one Swallow remain and the others depart?* The two Martins may have travelled southward with yesterday's N.W. wind, and have chosen to rest and recuperate here, and then pass on, but later observations, it will be seen, prove that they *did not proceed farther, nor show any desire to do so.*

Dec. 1st.—Strong N.W. wind. One Swallow only seen, strong and fit.

2nd.—*Two* Sand-Martins and one Swallow.

4th.—Wind N.W.; mild day. One Swallow only seen.

5th.—Wind N.W.; much colder. Two Sand-Martins, but *no* Swallow.

Note.—It will be observed that on some days the Swallow only was seen, and on other days the Martins were seen by themselves; while frequently the two species would be together disporting themselves over the water. No doubt when they were not all together the absent ones had gone farther afield in search of food, or taken longer flights around the district, thus accounting for their *apparent* departure, as was proved on succeeding days by their reappearance.

6th.—Wind N.E. One Swallow, two Sand-Martins.

7th.—Wind N.E. Four degrees of frost, white rimy frost this morning, and roads coated with ice. The three birds (both species) in evidence. The Sand-Martins are vigorous, but the Swallow seems very feeble, flying with evident labour just over the surface of the water, occasionally dipping its beak into the stream, and picking off an insect.

N.B.—From this date forward the observations, it will be seen, are almost a counterpart of those of 1905, and it is these facts which are so very interesting, and constitute so suggestive a study—I may almost venture to say, an unique and puzzling enigma—in ornithology.

8th.—Wind N.E. Keen rimy frost, with hard icy roads; change to rain in evening. *Two* Sand-Martins present; no Swallow.

9th.—Keen strong N.W. wind. Another hard frost last night,

and freezing hard all day. *One* Swallow and *two* Sand-Martins beating up and down stream in the cold N.W. wind, but hawking on the lee-side of willow trees and haystacks, which shelter the stream somewhat from the blast; birds quite close to the water, scarcely ever leaving the stream. Query: *Why do these birds linger on?* They are sure to perish!

In order to show how very keen the weather was at this time, and to what straits the birds were put to obtain food, I may mention that along the margins of the stream over which the Swallow and Martins were flying I observed the following species of birds which were seen fossicking for food at the same time (3.30 p.m.), *viz.*:—Stonechat, Meadow-Pipit, Wren, Grey Wagtail (see note *re* this bird for 1903), Robin, Starling, Song-Thrush, Blackbird, Sparrows.

10th.—Fine bright day. Wind N.W.; six degrees of frost last night. All *three* birds on the wing—the Sand-Martins wonderfully strong on the wing, and apparently unaffected by the cold weather; the Swallow seemingly very feeble, but still keeping on the feed, resting occasionally on a wire-fence. As I stood on the margin of the stream, I could easily have caught the Swallow in a butterfly-net, or have touched it with my stick, so tame or heedless of my presence did it appear. As it rested its wings drooped languidly downwards, showing a distinct patch of whitish feathers in the middle of the back. It was this patch which served to identify the bird as the same which had remained on from Nov. 25th. It hardly seems possible for this bird to survive through another night of keen frost.

11th.—Wind N.W. Thawing to-day; thick fog; heavy rain in evening; seven degrees of frost last night. To my great surprise, both Swallow and Martins on the wing, the latter fairly strong in flight, but the Swallow very feeble, taking short flights, resting a minute or so on the wire-fence, then backwards and forwards along the stream, occasionally sweeping the surface, and picking off an insect with evident effort—a magnificent struggle of animated nature against great odds. Which will win, bird or weather? Alas for the bird!

12th.—Wind W.; cold, piercing, strong wind. As I anticipated, Martins *only* in evidence to-day. The poor Swallow has evidently perished. I searched the ground below the wire-fence

where it rested yesterday in the expectation of finding its corpse, but failed to do so. It has probably died on its perch, or fallen into the stream, and, unable to recover itself, been carried away and drowned. It would be interesting to know its fate.

13th.—Cold west wind; frost last night. The *two* Sand-Martins still on the wing.

14th.—Wind N.W.; cold, raw, wintry day. *Very* hard frost last night; roads frozen and covered with ice. *One* Sand-Martin only to-day, flying *vigorously* up and down stream, snapping up the gnats from the surface as it skimmed along, with no evidence of feebleness or discomfort. The weather is so wintry that the Song-Thrushes, which have been in full song up to this week (9th), are now silenced, being too busy seeking food to think of singing; yet this belated summer bird seems to quite disregard the weather, and appears as strong and healthy as though it were midsummer.

15th.—Wind N.W.; dull cold day. *Both* Martins present to-day. I spent a couple of hours searching the beams, ledges, and floors of several barns and stables, where I thought it likely the Swallow, last seen on 11th inst., might have roosted at night, in the hope of finding its dead body, and thus satisfy myself that it had died a natural death (*i. e.* of cold and starvation), but my search was in vain. Evidently one of the Martins had yesterday made an excursion by itself away from its usual feeding haunts. A Grey Wagtail and a Snipe seen feeding by the stream to-day.

17th.—Wind N.W.; mild dull day. Birds still alive and well, but to-day high in the air above the trees, outhouses, and fields, yet never going far from the vicinity of the stream.

18th.—Weather and wind as yesterday. Birds very strong on the wing, and still circling high above the ground, and seemingly quite vigorous, and in no hurry to depart to warmer climes. The mild weather has once more incited the Song-Thrushes to commence singing again.

20th.—Wind changed to N.E.; weather much colder. The *two* birds still in evidence.

21st.—Wind N.E. Cold, with hard frost again. *To-day a strange and curious thing has happened—the two Sand-Martins have been joined by a* Swallow, *a poor, bedraggled, miserable-look-*

ing, half-dead object. There is absolutely no mistaking him (*a male*), *with his reddish throat and long-forked tail, and without doubt none other than the bird seen on Dec. 11th.* But—and here is the mystery, if we grant it to be *the same bird*—where in the interval has the bird been—*a matter of ten days*? When seen last (*vide* 11th inst.) the poor creature could scarcely fly, therefore it was quite incapable of taking a lengthy flight, and would scarcely be likely to go on a speculative journey in search of food when insects were fairly plentiful in the vicinity of the stream where it had fed so long. On the other hand, *is it possible for it to have existed for ten days without food*? Had it been in a semi-torpid condition during that time in some warm corner of an outbuilding, protected somewhat from the cold weather, and then, having been partly revived by the milder conditions which prevailed from 15th to 18th, managed for once to struggle out in search of a scanty meal? If so—and *we grant it possible* for a bird to exist thus in a semi-torpid state for several days—there might be some foundation for the accounts given of Swallows being seen in attics, church-towers, roofs of buildings, and other similar places, apparently dead; or of Sand-Martins being dug out of sand-pits and other sheltered places in a torpid condition, and actually returning to life when subjected to the effects of warmth. This *theory of semi-torpidity* does not seem to have been yet entirely refuted, though it is usually regarded as *impossible*, but I am inclined to think there may be "something in it." I would like to have the opinion of ornithologists regarding the disappearance of the Swallow on Dec. 11th, and its reappearance on Dec. 21st. It is quite certain that the Sand-Martins have not yet been in a torpid condition, as they have been observed almost every day from Nov. 29th.

(To be continued.)

NOTES AND QUERIES.

MAMMALIA.

Dolphin in Moy Estuary, Killala Bay.—The carcase of a Dolphin was left by the tide on the shore of one of my fields here on the 5th inst.; it was in an advanced stage of decomposition, having probably been killed some weeks previously by the Salmon fishermen. It was a male, 7½ ft. in length. I could not measure the dorsal fin or flukes, both being partly cut away; the flippers were 14 in. long from the shoulders, while from blow-hole to end of lower jaw measured 14 in.; the same distance from eye to end of lower jaw. The teeth were small and sharply pointed, those of the upper jaw fitting closely between those of the lower, and some of the teeth at end of upper jaw were wanting, but those of the lower were all perfect—*forty-eight on each side*. I have no books of reference by me, but suppose from the large number of teeth that the animal is the Common Dolphin (*Delphinus delphis*).—Robert Warren (Moy View, Ballina).

AVES.

Dipper (Cinclus aquaticus).—On April 14th I took a clutch of five Dipper's eggs. Being near the spot again on April 30th, I dropped down to have a look at the nest. The Dipper flew out as I approached, and, on examining, I found five fresh-laid eggs in the identical nest. Needless to say, I did not disturb this second laying. — T. Thornton Mackeith (The Hall, Caldwell, Uplawmoor).

Tree-Sparrow (Passer montanus) in Denbighshire.—In the Dulas Valley, about three miles above Llandulas, there is a colony of Tree-Sparrows. The birds mostly nest in some ivy-covered oaks in the hedgerows which border the high road, but one pair, which Mr. W. Brownsword and I watched on May 22nd, was feeding young in a hole in an ash. This species has been observed near Wrexham, and in the Ceiriog Valley (W. H. Dobie, Proc. Chester Soc. Nat. Sci. and Lit. i. No. iv. p. 298), and is, perhaps, not so rare in Denbighshire as is generally supposed. There are, however, few definite records of its occurrence in North Wales.—Charles Oldham.

Late Appearance of Bramblings in Sussex.—During the winter, from Jan. 22nd onwards, there was one flock of Bramblings (*Fringilla montifringilla*) near Tunbridge Wells, but these left about the middle of March, and but for two on March 28th we saw no more until April 16th. From that date to the 22nd they were quite abundant; altogether we saw them in four widely separated places during that time, on two of these occasions in considerable numbers, with other Finches. Other winter visitors stayed unusually late in the district—Redwings until April 16th, and Fieldfares until the 23rd (at least). On the 29th I saw a flock of Fieldfares in Surrey. — H. G. Alexander (3, Mayfield Road, Tunbridge Wells).

Notes on the Cuckoo.—On May 23rd I found, in a rough grass-field near Diss, a Meadow-Pipit's nest containing three eggs of the owner and two Cuckoos' eggs. These eggs, laid by different Cuckoos, are certainly the produce of the same two birds which each deposited an egg in a Meadow-Pipit's nest near the same place last June (*cf.* Zool. 1906, p. 276), and that two hen Cuckoos should have survived the perils of a double migration, returned to the same place, and once again made choice of the same nest in which to place their eggs seems worthy of record. — Julian G. Tuck (Tostock Rectory, Bury St. Edmunds, Suffolk).

Rough-legged Buzzard (Archibuteo lagopus) in Cheshire. — On Nov. 5th, 1906, at Knutsford, a gamekeeper shot a Rough-legged Buzzard, which was devouring a snared Rabbit. The bird is in immature plumage, having the basal half of the tail brown.—Charles Oldham.

Osprey near Plymouth, and other Notes.—I have just seen an Osprey (*Pandion haliaëtus*), shot by a gamekeeper at Bickleigh Bridge, which spans the Plym about seven miles from Plymouth. It was shot in September, 1905. The gamekeeper told me the wings measured from tip to tip 66 in. He first fired at it below the bridge as it rose. The bird alighted further up the valley, where it was secured by a second shot. He did not know what kind of bird it was until I identified it. Among the birds of note which have been seen around Plymouth during the present year I may mention a Peregrine Falcon, which remained for several days between Penlee Point and Rhame Head. It was seen on Good Friday, and again on Easter Monday. A few years ago a female Peregrine was trapped near the same spot by the gamekeeper at Mount Edgcumbe. Towards the end of last month (April) I saw an Egyptian Goose on Plymouth Racecourse, but it was

gone when I looked for it again the following week. On May 5th I visited Wembury Cliffs, the breeding-place of the Herring-Gulls. I was sorry to see that the Raven's nest has been interfered with again. A pair have bred there from time immemorial, but for the last several years, to my knowledge, the young have either been taken or destroyed. Last year they were shot in the nest, and left there. The year before two of the young were sold to doctors in Plymouth, and now I see the nest is deserted, although I saw the female sitting in it last March, whilst the old male was flying about chasing the Jackdaws and Gulls in his usual quarrelsome way. There is, however, I am glad to say, no fear of the extinction of the Raven in Devon and Cornwall for a very long time to come, as they have many secure nesting-sites in both counties. I walked back to Plymouth by the coast, and saw the first flock of Whimbrel on the rocks near Bovisand. There were about fifteen of them.—H. P. O. Cleave (18, Leigham Street, The Hoe, Plymouth).

Sanderling (Calidris arenaria) in Cheshire.—On May 26th there was a Sanderling in nearly complete breeding dress on the mud at Cotebrook mill-pond, near Tarporley. With it was a Ringed Plover, a bird of the small non-resident race.—Charles Oldham.

Birds killed by Telegraph-wires near Yarmouth.—On April 23rd an example of the Land-Rail or Corn-Crake (*Crex pratensis*) was picked up on the New Road, between Yarmouth and Acle. It had evidently been killed by striking the telegraph-wires the night previous. It was in fine condition, and its plumage was uninjured. A Spotted Crake (*Porzana maruetta*) also met with a similar accident by striking the same wires on Aug. 27th, 1904. Both specimens are in my possession. —B. Dye (60 Row, Great Yarmouth).

Sexual Selection.—My attention has been lately drawn to a description of the nuptial "dance" and song of the King Bird of Paradise (*Paradisea regia*, also *Cicinnurus regius*), as given in a recent number of the 'Ibis' by Sir William Ingram, whose observations were made upon a captive specimen in his possession. In this account the following occurs: —"He bends down on the perch in the attitude of a fighting-cock, his widely-opened bill showing distinctly the light apple-green colour of the gullet, and sings the same gurgling notes, without once closing his bill"—having, as I gather, previously sung them in the usual way. This, as it appears to me, is strong confirmation of a view which I believe I have been the first to bring forward, *viz.* that the bright colouring of the buccal cavity in various birds—as *e.g.* the Shag, Razorbill, Guillemot, Kittiwake, &c.—taken in conjunction with the display made of it during the season of nuptial activity, is only to be

explained on the principles of sexual selection as enunciated by Darwin. Inasmuch as the protective theory, with its offshoots of recognition-marks, warning coloration, &c., seems here excluded, this question has an important bearing on that of sexual selection generally. Those, indeed, who believe bright colours to be but the effect of high vitality may claim the blazing gullet of the Shag as due to this cause alone; but why, then, is the frequent and striking revealment of it a very marked feature in the bird's nuptial philanderings? At pp. 169, 170, and 176 of my "Bird Watching,' and more particularly at pp. 55, 56, 123—131, and 210, 211 of my 'The Bird Watcher in the Shetlands,' I have endeavoured to direct attention to this interesting and crucial point, but what I have had to say has hardly received a comment.—Edmund Selous.

[Darwin ('The Descent of Man,' ed. ii. p. 426) called attention to the fact of the inside of the mouth of *Buceros bicornis* being black in the male and flesh-coloured in the female, but did not consider it explainable by his theory of sexual selection.—Ed.]

Artificial Additions to the British Fauna.—Last summer we turned out some Red-crested and Dominican Cardinals. Some of them remained with us all the winter, coming to feed with the wild birds on the food-trays in my garden. There is now a nest of young Red-crested Cardinals in the garden. The nest is very high up in an old cedar tree. I feel sure that one if not two other pairs have nests, but have not yet been able to find them.—M. Bedford (Woburn Abbey, Woburn).

REPTILIA.

Water-Tortoises (Emys orbicularis) in England.—In the summer of 1890 or 1891 we turned six full-grown Water-Tortoises into a small artificial pond in the garden. Soon afterwards one was brought back by a man who said he had ploughed it up in a field a quarter of a mile away. A second was also brought back from some distance off. They hybernate during the winter, and reappear in April. The bottom of the pond is concrete, so that they cannot bury themselves in the mud. They occasionally get bits of meat, but are able to live on worms, dead gold-fish, and such other food as they find. Two of the original six were alive last summer, having survived about sixteen English winters. They may be still alive, but as last year we put in two others they cannot be identified. They spend the sunny hours on the edge, and slip into the water as one approaches. Their sight is exceedingly keen. I should be curious to know whether any have survived so long in this country in the open air.—Harold Russell (Shere, Guildford).

OBITUARY.

Frederic Moore.

This well-known Indian lepidopterist passed away on May 10th at his residence, Maple Road, Penge, S.E. He was born on May 13th, 1830, at 33, Bruton Street, Berkeley Square, and was introduced as a youth to Dr. J. E. Gray, who then required someone to draw Tortoises for him. While so engaged he attracted the attention of Dr. Horsfield, who was also in need of one capable of making natural history drawings, and shortly afterwards joined the staff of the East India Museum, then located in Leadenhall Street, City of London. He remained in this institution till its absorption with the National Museum, and then passed the remaining days of his busy leisure in following his favourite pursuit. He was an indefatigable worker, and, beyond numerous papers published by different scientific societies, his principal works are—'A Catalogue of the Lepidopterous Insects in the Museum of the Hon. East India Company,' two vols. (1857–59), which was written conjointly with Dr. Horsfield, whilst he alone wrote 'The Lepidoptera of Ceylon,' in three vols. (1880–87), and was engaged in his great work, 'Lepidoptera Indica,' to the actual time of his death, and of which six volumes have appeared.

Dr. Moore was an ardent and old-time naturalist. His path was remote from the stream of evolutionary conception; to him it was sufficient to describe the vast host of species which still awaited recognition, and to this work he brought an eye so trained for observing the most minute differences, that his species were not always accepted by his colleagues. The lumpers considered him a splitter. He thus incurred during his later years a considerable amount of severe criticism, but possessing that dogged determination found only in quiet men—and he was one of the quietest of men—it left him practically unaffected, and he conscientiously continued his work according to his light to the end. He was pioneer in the study of Indian Lepidoptera, and he knew these insects intimately better than any man living. In private life he was an upright man, with a serene disposition which trouble did not impair. His career was self-made and without reproach.

NOTICES OF NEW BOOKS.

European Animals; their Geological History and Geographical Distribution. By R. F. Scharff, Ph.D., B.Sc., &c. Archibald Constable & Co., Ltd.

This book is a storehouse of facts which take precedence of theory, a welcome innovation to the frequent publication of a theory to which the facts are only subsidiary. The opening sentence of the book is the text throughout: "The geological history of our animals is largely the history of their past wanderings." The method of treatment is a sectional one. Ireland, Scotland, England and Wales, occupy separate chapters, and others are devoted to different European regions; while many outline maps show the distribution of a particular animal or plant. This procedure focuses the local information, and simplifies the argument, while at the same time it makes the work available as a work of easy reference. And this is the merit of any standard work. To read a book in haste and then put it on the shelf for ever is death and destruction to its writer, however much we may bepraise the derelict. The well-thumbed volume that promotes discussion lives longer than the volume possessing the imprimatur of general acceptance.

Dr. Scharff is very familiar with the Irish fauna, and he writes:—"Taking into consideration the testimony yielded by the remains contained in the recent English Tertiary and post-Tertiary deposits, I am of opinion that the whole of the existing Irish fauna and flora is of pre-Glacial Age."

There are no footnotes, an appendix giving a list of works and papers which have been most frequently consulted. There appear to be a few slips in this or the converse. At p. 124 we read of Messrs. Wright and Upham as authors of a little work on Greenland, and on referring to the appendix can only find a reference to Wright and Warren.